

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) CIRCUIT BREAKER WITH IMPROVED THERMAL-MAGNETIC TRIPPING MECHANISM

(71) We, GENERAL ELECTRIC COMPANY, residing at 1 River Road, Schenectady 12305, State of New York, United States of America; a corporation organised and existing under the laws of the State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

Over the past several years, there has been a growing demand for reduction in the width of circuit breakers so as to facilitate minimization of the panel board assemblies or the utilization of a pair of circuit breakers side-by-side on a single line stab of a panel board which might otherwise seat only a single larger width breaker. In addition, there has been a growing desire to improve the predictability of operation of the thermal-magnetic tripping means and to facilitate the calibration thereof. Further problems have been introduced by the introduction of common trip members for simultaneously tripping coupled breakers.

It is an object of the present invention to present a novel circuit breaker construction utilizing a thermal-magnetic tripping means readily adapted to casings of relatively small width and nevertheless able to carry short circuit currents effectively while affording long lived rapid operation.

It is also an object to provide such a circuit breaker construction wherein the thermal-magnetic elements may be fabricated and assembled with relative facility and economy.

Another object is to provide such a circuit breaker construction wherein use of a common trip member is readily accommodated and possible damage thereby to the thermal-magnetic means is precluded.

Still another object is to provide a thermal-magnetic means for a circuit breaker which is readily adapted to facile calibration and in which operation is not highly sensitive to minor deviations in tolerance or calibration.

Summary of the Invention

It has now been found that the foregoing and related objects can be readily attained in a circuit breaker wherein the casing has a releasable cradle pivotably mounted at one end therein and an elongated latch member having its lower end portion latchinglly engaged with the free end of the cradle. An elongated magnet member in the casing has a generally U-shaped field portion adjacent its lower end opening towards and spaced from the lower end portion of the latch member. Means in the casing provide a pivotal connection between the upper end portions of the latch and magnet members for relative movement therebetween and pivotally support the upper end portions of the latch and magnet members for pivotal movement about a common pivot for simultaneous pivoting thereof relative to the free end of the cradle. Biasing means pivot the lower end portion of the latch member toward the free end of the cradle so as to encourage latching engagement therebetween, and a bimetallic strip pivotally mounted at one end extends through the field portion of the magnet member to generate a magnetic field therein upon passage of current therethrough.

The bimetallic strip is deflectable by a sustained short circuit current of relatively low magnitude flowing therethrough to pivot the latch member against the pressure of the biasing means away from the free end of the cradle, thereby releasing the cradle and tripping the breaker. Upon passage of a sudden relatively high short circuit current flowing through the bimetallic strip, a magnetic field will be generated in the field portion of the magnet member which is of sufficient magnitude to pivot the latch member about the pivot between the latch and magnet members and towards the field portion, thereby effecting release of the cradle and tripping of the breaker.

In the preferred embodiment of the present invention, the bimetallic strip will norm-

ally act upon the magnet member to effect pivoting thereof and the magnet member in turn will act upon the latch member to effect pivoting thereof and release of the cradle since the members are pivotable together about a common pivot point. To effect such movement of the latch member, engagement must be provided between the latch and magnet members most conveniently by a hook-shaped element or the like which will engage the lower end of the latch member upon pivoting of the magnet member in a direction away therefrom.

This arrangement permits the latch member to pivot towards the magnet member about the pivot therebetween when a common trip member is employed and thus precludes damage which might result from the use of a stationary magnet member or a structure in which the bimetallic strip carries the field piece and closely coupled to the latch member to effect tripping thereof.

The invention will become more readily apparent from the following description of a preferred embodiment thereof shown, by way of example, in the accompanying drawings in which:

Figure 1 is a side elevational view of an electric circuit breaker embodying the present invention with one side of the insulating casing removed to show internal construction;

Figure 2 is a sectional view of the circuit breaker of Figure 1 generally along the line 2—2 thereof;

Figure 3 is a fragmentary, partially diagrammatical view showing the operating mechanism in the "on" condition;

Figure 4 is a similar view showing the operating mechanism in the "tripped" condition;

Figure 5 is a fragmentary sectional view thereof on an enlarged scale illustrating the tripping mechanism;

Figure 6 is an exploded view of the thermal-magnetic tripping mechanism of the circuit breaker of Figure 1;

Figure 7 is a fragmentary elevational view of an alternate embodiment of thermal-magnetic trip construction;

Figure 8 is a view similar to Figure 7 drawing in phantom line the displacement of the main bimetallic strip provided by the ambient bimetallic strip; and

Figure 9 is a perspective view of the magnet-ambient bimetallic member subassembly of Figure 7.

Referring now to Figures 1—6 of the drawings in detail, an electric circuit breaker embodying the present invention has a molded insulating casing provided by a pair of inter-fitting sections generally designated by the numerals 10, 12 which are secured together by fasteners (not shown) seated in the apertures 14 therein. Each of the sections has a complex interior surface configuration pro-

viding ribs, shoulders, apertures and recesses as will be described more fully hereinafter in connection with the various parts of the operating mechanism.

At the front end of the casing is a line terminal generally designated by the numeral 16 which has at one end a pair of clamping jaws 18 biased together by a spring clip 20 extending through an aperture in the wall of the sections 10, 12 for engagement with a stab or contact of a panel board (not shown). The terminal 16 fits over a shoulder or rib 21 formed on the casing sections 10, 12 and has a stationary contact 22 at its other end.

A movable contact 24 is carried by the lower end of the contact arm generally designated by the numeral 26 for movement into and from electrical engagement with the stationary contact 22. As best seen in Figure 2, the contact arm 26 is fabricated from sheet metal to minimize thickness of the breaker and has a laterally extending finger 28 at its upper end which is pivotally mounted in the aperture 30 of the operating handle generally designated by the numeral 32. The upper portion 34 of the contact arm 26 is generally planar and extends adjacent the sidewall 36 of the casing section 12 and to the side of the operating handle 32. At its center is an offsetting portion 38 with a pair of apertures 40 therein and extending transversely of the casing below the operating handle 32. The lower portion 42 of the contact arm 26 is generally L-shaped with its vertical portion extending generally planar adjacent the sidewall 44 of the casing section 10 and its horizontal portion carrying the movable contact 24.

Engaged at one end in the apertures 40 of the contact arm 26 is a tension spring 46 which has its other end engaged in a notch or recess 48 in the upper edge of the cradle generally designated by the numeral 50. In this manner, the spring 46 applies biasing pressure on the contact arm 26 toward the handle 32 and cradle 50 which ensures rapid snap action into open or closed contact position as it pivots about the handle 32. As best seen in Figure 2, by having the upper edge of the finger 28 cut at a slight angle to the horizontal (about 8 to 15 degrees) and a cooperating taper in the aperture 30 of the handle 32, the upper portion 34 of the contact arm 26 is drawn toward the side surface of the handle 32 for sliding movement thereon to avoid friction on the casing sidewall 12 and also facilitate retention of the elements during assembly. The lower portion 42 slides along the surface of the rib 45 on the sidewall 44 of the casing section 10.

The operating handle 32 has a hub portion 52 with diametrically extending ribs 54 on either side having a notch 56 in the upper edge thereof and which pivotally seat in cooperatively configured and dimensioned gener-

ally butterfly-shaped recesses 58 in the side-walls 36, 44 of the casing sections 10, 12 so as to be pivotally supported thereby. A grip portion 60 extends outwardly of the casing through an aperture 62 in the top wall 64 of the casing sections 10 for manual engagement. A depending portion or extension 68 extends into the casing and has the aperture 30 therein pivotally supporting the contact arm 26.

The cradle 50 is a relatively thin member disposed between the operating handle 32 and the sidewall 44 of the casing 10. It has a generally inverted U-shaped configuration with a pair of legs 70, 72 and a center portion 74 having the notch 48 in its upper edge into which the spring 46 is hooked. The forward leg 70 has a generally circular end portion 76 which is pivotally retained in co-operatively configured recesses 78 formed in the sidewalls 36, 44 of the casing sections 10, 12 so that the cradle 50 may pivot thereabout. To prevent binding of the cradle 50 between the casing sections 10, 12 due to deflecting pressure on the sidewalls, a spacing boss 80 is provided on the sidewall 44 of casing section 10 which extends through an elongated slot 82 in the cradle rear leg 72. As the cradle 50 pivots about the end portion 76, the boss 80 will slide freely within the slot thereof.

At its upper end, the cradle front leg 70 has a laterally inwardly extending tab 84 at its front edge which is adapted to be engaged by the depending portion 68 of the operating handle 32 when it is moved to the "off" position shown in Figure 1 so as to produce pivoting of the cradle 50 from the "tripped" condition shown in Figure 4. The further pivoting of the handle 32 in the clockwise direction past the "off" position lifts the cradle 50 into the latched condition. When the cradle 50 is released from the latch 90, it rotates clockwise as viewed in Figure 1, carrying the upper end of the spring 46 across the line of centers of the spring anchor point 40 on contact member 26 and pivot 28 on handle 32. This causes the spring 26 to rotate the contact arm 26 toward open condition. As the contact arm 26 moves to open condition, the toggle system comprising handle pivot 32a, contact arm pivot 28, and spring anchor point 40 collapses by movement of the mid-point 28 to the left as viewed, rotating the handle clockwise. The clockwise rotation of the handle 32 is limited by its engagement with tab 84 of the cradle 50. A second laterally inwardly extending tab 86 is provided on the rear edge of the front leg 70 at a point spaced downwardly from the tab 84 so that it will strike the contact arm 26 upon tripping of the breaker in the event that the stationary contact 22 and movable contact 24 are fused together by a short circuit current and thus break them apart.

The rear leg 72 of the cradle 50 has a latch portion 88 at its lower end providing a shoulder or edge which is latched or engaged with a tab 90 (Figs. 5, 6) adjacent the lower end of the latch member generally designated by the numeral 92 in the normal operating or untripped condition of the breaker. The upper end portion of the latch member 92 has laterally extending shoulder portions 94a, 94b with rearwardly extending arms 96a, 96b at the lower end thereof, and the shoulder portion 94a seats in the recess 98 in the sidewall 44 of the casing section 10. The arms 96a, 96b slidably seat on a downwardly sloping shoulder 100 of the recess 98 in the sidewall 44 of the casing section 10.

Mounted on the arms 96a, 96b of the latch member 92 is the laterally extending finger 110 of the magnet member generally designated by the numeral 112. The finger portion 110 extends towards the arms 96a, 96b sloping away from them so as to provide a diverging spacing between the opposed surfaces of the finger portion 110 and latch member 92 (see Fig. 5). The latch member 92 is biased about the pivot provided by the bottom edge of the finger 110 of the magnet member 112 in a clockwise direction and into latching condition by a compression spring 106. A recess 108 in the sidewall 44 of the casing section 10 provides a seat for one end of the spring 106 and the other end fits over a forwardly extending tang 109 upon the upper end of the latch member 92 spacing above the point of its pivot with magnet member 112.

The magnet member 112 pivots about a point on the rearwardly angled shoulder 113 of the recess 98 in the sidewall 44 which is spaced slightly above the pivot point between the magnet member 112 and latch member 92. As a result, the spring pressure on the latch member 92 above its pivot with the magnet member 112 produces a scissors-type action with the result that the latch member 92 tends to rotate in a clockwise direction and the magnet member 92 tends to pivot in a counterclockwise direction. The pivot point for both members to act in unison is the pivot point of the magnet member 112 on the shoulder 113 of the recess 98.

The magnet member 112 is fabricated from a magnetically susceptible metal and has a field portion 114 of generally U-shaped cross section opening toward the latch member 92 adjacent the lower end thereof and an arm portion 116 extending upwardly from one leg of the field portion 114 along the sidewall 36 of the casing section 10 with the finger 110 at the upper end thereof. A generally U-shaped hook element 118 of non-magnetic metal extends forwardly from the other leg of the field portion 114 and engages the lower end of the latch member 92 in the normal operating condition.

An elongated bimetallic strip 120 extends through the field portion 114 of the magnet member 112 from a recess 122 in the casing sidewall 44 spaced rearwardly of the recess 98 and having a rearwardly tapering rear wall 123 and wherein its upper end is joined to the terminal strap 124 by brazing, welding or the like. A flexible conductor 126 extends between its lower end below the field portion 114 and the center portion 38 of the contact arm 26 to provide the electrical path through the breaker from the terminal strap 124. The terminal strap 124 extends through a slot 128 in the casing section 10 after passing about an inwardly projecting boss 129 on the casing section 10 so that it and the wall 123 provide a two point support for the strap 124 outwardly from the wall surface of the casing section 10 therebetween. The outer end of the conductor strap 124 has a load conductor lug 130 thereon disposed in cooperatively configured recesses 132 in the casing section sidewalls 36, 44 to secure a conductor (not shown) from a load thereto. The terminal strap 124 is secured in the casing by the retaining screw 136 which is threadably engaged therein and extends through a slot 138 in the casing section 10. By turning the screw 136, the center portion of the strap 124 between the wall 123 and boss 129 can be drawn toward the wall surface adjacent the screw 136 to produce deflection. The upper end of the terminal strap 124 and the bimetallic strip 120 are displaced forwardly within the recess 122 by the deflection, thus altering the position of the fixed end of the bimetallic strip 120 and thereby permitting calibration to a desired temperature rise before it will act upon the magnet member 112 to effect tripping of the breaker.

To assist in heat dissipation and extinguishing of an arc drawn between the contacts 22, 24 upon opening thereof, a metal arc chute 140 is provided and secured in position by the line terminal 16 and the bosses 142 on the sidewalls 36, 44 of the casing sections 12, 10. Hot gases are vented through the channel 144 provided in the sidewalls 36, 44 of the casing sections 12, 10. An insulating element 146 is fitted over the line terminal 16 and tends to isolate the line terminal 16 from the surrounding structure and provide a better dielectric path.

In operation of this embodiment, current flows from the line terminal 16 to the contact arm 26 through the closed contacts 22, 24 and thence to the bimetallic strip 120 through the flexible conductor 126. As the current flows upwardly through the bimetallic strip 120 to the terminal strap 124, a magnetic field is generated in the field portion 114 of the magnet member 112 which attracts the latch member 92 toward it but the biasing pressure of the compression spring 106 is sufficient to

offset the magnetic attraction thus generated during normal operation of the breaker. The normal spacing or magnetic gap of the two members is determined by the hook element 118 which engages the two and prevents them from pivoting apart to a greater distance. However, upon generation of a sudden high overload current of predeterminable magnitude, the magnetic field will be increased sufficiently to overcome the pressure of the spring 106 and pivot the latch member 92 and magnet member 112 relative to each other. Initially, the magnet member 112 will tend to pivot toward the latch member 92 until further movement is blocked by the bimetallic strip 120. Thereafter, pivoting of the latch member 92 toward the magnet member 112 will take place until the latch portion 88 of the cradle 50 slides from the tab 90 on the latch member 92.

Upon release of the latch portion 88 of the cradle 50, the spring 46 pivots the cradle 50 downwardly or clockwise as seen in Figures 3 and 4 about the pivoted circular end portion 76. As it pivots, the front tab 84 thereon strikes the depending portion 68 of the operating handle 32 producing counterclockwise pivoting thereof. As the cradle 50 pivots, the line of action of the spring 46 passes the pivot point for the contact arm 26 in the operating handle 32 with the result that the toggle action snaps the contact arm 26 about its pivot in a counterclockwise direction to open the contacts 22, 24 and produce the magnetically tripped condition indicated in Figure 4. Pivoting of the contact arm 26 is limited by the stop boss 148 on the casing sidewall 44.

Resetting of the breaker mechanism is effected by pivoting the operating handle 32 from the tripped position shown in Figure 4 in the clockwise direction to the full extent permitted which produces pivoting of the cradle 50 by reason of the abutment of the depending portion 68 against the front tab 84. This elevates the rear leg 72 until the latch portion 88 clears the tab 90 on the latch member 92 which is biased by the spring 106 towards the cradle 50 to produce latching thereof and the condition illustrated in Figure 1.

Tripping of the breaker can also be effected by a sustained short-circuit current of low magnitude which will produce bending of the bimetallic strip 120 in the direction of the transverse web of the field portion 114 of the magnet member 112. As the bending continues, the bimetallic strip 120 will bear against the field portion 114 and pivot the magnet member 112 in a counterclockwise direction which, in turn, will draw or pivot the latch member 92 in the same direction by reason of the engagement of the hook element 118 therewith. As pivoting continues, the tab 90

disengages from the latch portion 88 of the cradle 50 and tripping occurs.

In the illustrated embodiment, there is also shown means for effecting common tripping action with another breaker in a multi-pole arrangement. A common tripping member, generally designated by the numeral 158, has ears 160 adjacent the upper end thereof which pivotally seat in recesses 162 in the sidewalls 36, 44 of the casing sections 12, 10. At its lower end it has a transversely extending bar 164 adapted to bear against the latch member 92 upon pivoting thereof in the counterclockwise direction so as to effect release of the cradle 50 in the event of pivoting thereof by action of another breaker through a trip interlock (not shown) seated in the slot 166 therein.

Upon tripping of the breaker through action of either the thermal or the magnetic tripping means, the cradle 50 will cam against the lower portion of the common tripping member 158 to produce pivoting thereof in the counterclockwise direction which is thereby translated into equivalent movement of a common tripping member in another breaker coupled therewith.

Manual operation of the breaker between "on" and "off" positions is readily effected through pivoting of the operating handle 32 between the positions shown in Figure 1 and Figure 3. As the depending portion 68 pivots the upper end of the contact arm 26 through the line of action of the spring 46, the resultant toggle action opens or closes the contacts 22, 24.

Turning now to the embodiment of Figures 7 through 9, there is provided means for compensating the effect of ambient temperature variations upon the bimetallic strip 120. A relatively short ambient bimetallic strip generally designated by the numeral 170 is secured at its upper end to the field portion 114 of the magnet member 112 at the point A by welding or the like to provide a point about which it may bend. The lower end portion 172 is offset towards the bimetallic strip 120 and will normally bear thereagainst and will flex away therefrom as a result of temperature changes.

In operation of this embodiment, the bimetallic strip 120 will not normally engage the magnet member 112 directly to effect pivoting thereof in response to short circuit current flow but will effect the pivoting thereof through the ambient bimetallic strip 170. However, increase in ambient temperature producing flexure of the bimetallic strip 120 in the unlatching direction as contrasted with a temperature increase produced by a short circuit current will simultaneously produce flexure of the ambient bimetallic strip 170 in the same direction so that pivoting of the magnet member 112 is not effected. The degree of the normal offset in the lower end

portion 172 determines the ambient temperature gradient compensatable before the bimetallic strip 120 bears against the field portion 114 of the magnet member 112 to effect pivotal movement thereof and tripping.

In the illustrated embodiment, the latch and magnet members 92, 112 are shown as having a common pivot provided by the slope of the shoulder 113 defining a wall of the recess 98 in which their upper end portions are received, and the face of the pivot finger 110 of the magnet member 112 slopes away from the opposed surface of the latch member 92. Although this particular arrangement has proven highly beneficial because of the scissors-type pivoting action generating a controlled spacing therebetween and the optimum operation afforded thereby, the magnet member 112 and the latch member 92 may also pivot about a common pivot provided by the support surface for the latch member 92. Alternatively, the magnet member 112 may provide arms upon which shoulders on the latch member 92 are pivotally supported and these arms in turn would be pivotally supported on a support shoulder of the casing.

Where the common pivot is below the pivot point between the two members, they will tend to pivot in the same direction in response to the biasing action of the spring so that means for providing the desired spacing therebetween must be provided, such as the bimetallic strip or a shoulder on the casing limiting the pivotal movement of the magnet member towards the latch, or a spring acting therebetween. Instead of using angular shoulders on the casing to provide the support and pivot surfaces, pivot pins and other suitable mounting means can be employed albeit with an increase in number of parts and problems of assembly.

In the illustrated embodiment, the hook element 118 on the magnet member 112 establishes the magnetic gap accurately and it remains constant whether the circuit breaker is cold or hot. If so desired, the latch portion 88 of the latch member 92 may have a projection thereon extending towards the cradle 50 and limiting the amount of surface contact between the tab 90 and the latched end of the releasable cradle 50 so as to minimize the amount of pivoting of the latch member required to effect tripping of the breaker. Such an arrangement is particularly desirable with breakers of low current rating when they are cold to increase their sensitivity.

It will be readily appreciated that the illustrated embodiment affords significant advantages from the standpoints of ease of fabrication of the several elements and of ease of assembly of the elements. In assembling the thermal-magnetic tripping mechanism, the assembly of the terminal strap 124 and bimetallic strip 120 is dropped into its slot 128 of the casing with the joined upper ends thereof disposed in the recess 122 of the casing

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section 10. The retaining screw 128 is then inserted in the slot 138 of the casing and engaged with the terminal strap 124. The magnet member 112 and latch member 92 are then seated in the recess 98 of the sidewall 44 with the magnet member 92 being rotated into position about the bimetallic strip 120. Insertion of the compression spring 106 over the tank 109 on the latch member 92 and into the recess 108 of the sidewall 44 then applies the biasing pressure to these two elements. Upon completion of the assembly, the retaining screw 136 is tightened to provide the desired calibration of the bimetallic strip 120.

By reason of the relatively long length of the bimetallic strip and its arrangement within the assembly, it can be seen that a highly effective low level magnetic strip is provided while at the same time minimizing its sensitivity from the standpoint of calibration. Similarly the magnetic trip is rendered highly responsive to short circuit currents at levels which may be relatively low dependent upon the desired point of operation of the tripping mechanism.

Although the operating mechanism of the illustrated embodiment is optimum from the standpoint of competence, and ease of construction and assembly, it will be appreciated that the thermal-magnetic tripping mechanism of the present invention may be utilized with other more conventional types of operating mechanism. It will also be appreciated that other more conventional means for effecting calibration of the bimetallic strip can be employed such as a screw acting directly upon the upper end portion of the terminal strap and bimetallic strip to shift the bending point thereof.

Thus it can be seen from the foregoing detailed specification and the accompanying drawings that the circuit breaker of the present invention provides a thermal-magnetic tripping mechanism readily adapted to relatively small widths while still affording highly effective means for handling substantial circuit currents. The interrelation of the parts permits a minimization of parts and the size of the assembly while affording optimum coaction therebetween. The several parts can be readily fabricated and easily assembled rapidly and with minimum likelihood of improper assembly.

Other features of the invention hereinbefore described are claimed in co-pending application No. 37388/68 (Serial No. 1227805).

WHAT WE CLAIM IS:—

1. A circuit breaker comprising a casing, a releasable cradle having one end portion pivotally mounted in said casing, a latch member having its lower end portion latchingly engaged with the other end portion of said

cradle, a magnet member having a generally U-shaped field portion adjacent its lower end opening towards and spaced from the lower end portion of said latch member, means in said casing providing a pivotal connection between the upper end portions of said latch and magnet members for relative movement therebetween and pivotally supporting said upper end portions of said latch and magnet members for pivotal movement as a unit about a common pivot for simultaneous pivoting thereof relative to said casing and relative to said cradle other end portion, said latch member and said magnet member being pivotally movable with respect to each other, biasing means pivoting said lower end portion of said latch member towards said cradle other end portion, and a bimetallic strip fixed at one end and extending through said field portion to generate a magnetic field therein upon passage of current therethrough, said bimetallic strip being deflectable by a sustained short circuit current of relatively low magnitude flowing therethrough to pivot said latch member and said magnet member about said common pivot in a direction so as to move said lower portions of said latch member and said magnet member away from said cradle against the pressure of the biasing means and thereby to release said cradle, said bimetallic strip upon passage of a sudden relatively high short circuit current flowing therethrough generating a magnetic field in said field portion of said magnet member of sufficient magnitude to pivot said latch member relative to said magnet member in a direction towards said field portion and thereby to release said cradle.

2. A circuit breaker as claimed in claim 1, wherein said bimetallic strip deflects into contact with said lower end of said magnet member upon passage of a sustained short circuit current therethrough to effect pivoting thereof and wherein said magnet member is engageable with said latch member to effect pivoting thereof upon said pivotal movement thereof by said bimetallic strip so as to release said cradle from said latch member.

3. A circuit breaker as claimed in claim 2, wherein connecting means are provided between said latch and magnet members to provide the engagement therebetween.

4. A circuit breaker as claimed in claim 1, wherein said bimetallic strip limits movement of said magnet member towards said latch member.

5. A circuit breaker as claimed in claim 1, wherein said biasing means acts upon said latch member above the pivotal connection between said latch and magnet members.

6. A circuit breaker as claimed in claim 5, wherein the common pivot for said magnet and latch members is spaced toward the upper ends thereof from said pivot therebetween



section 10. The retaining screw 128 is then inserted in the slot 138 of the casing and engaged with the terminal strap 124. The magnet member 112 and latch member 92 are then seated in the recess 98 of the sidewall 44 with the magnet member 92 being rotated into position about the bimetallic strip 120. Insertion of the compression spring 106 over the tank 109 on the latch member 92 and into the recess 108 of the sidewall 44 then applies the biasing pressure to these two elements. Upon completion of the assembly, the retaining screw 136 is tightened to provide the desired calibration of the bimetallic strip 120.

By reason of the relatively long length of the bimetallic strip and its arrangement within the assembly, it can be seen that a highly effective low level magnetic strip is provided while at the same time minimizing its sensitivity from the standpoint of calibration. Similarly the magnetic trip is rendered highly responsive to short circuit currents at levels which may be relatively low dependent upon the desired point of operation of the tripping mechanism.

Although the operating mechanism of the illustrated embodiment is optimum from the standpoint of competence, and ease of construction and assembly, it will be appreciated that the thermal-magnetic tripping mechanism of the present invention may be utilized with other more conventional types of operating mechanism. It will also be appreciated that other more conventional means for effecting calibration of the bimetallic strip can be employed such as a screw acting directly upon the upper end portion of the terminal strap and bimetallic strip to shift the bending point thereof.

Thus it can be seen from the foregoing detailed specification and the accompanying drawings that the circuit breaker of the present invention provides a thermal-magnetic tripping mechanism readily adapted to relatively small widths while still affording highly effective means for handling substantial circuit currents. The interrelation of the parts permits a minimization of parts and the size of the assembly while affording optimum coaction therebetween. The several parts can be readily fabricated and easily assembled rapidly and with minimum likelihood of improper assembly.

Other features of the invention hereinbefore described are claimed in co-pending application No. 37388/68 (Serial No. 1227805).

WHAT WE CLAIM IS:—

1. A circuit breaker comprising a casing, a releasable cradle having one end portion pivotally mounted in said casing, a latch member having its lower end portion latchinglly engaged with the other end portion of said

cradle, a magnet member having a generally U-shaped field portion adjacent its lower end opening towards and spaced from the lower end portion of said latch member, means in said casing providing a pivotal connection between the upper end portions of said latch and magnet members for relative movement therebetween and pivotally supporting said upper end portions of said latch and magnet members for pivotal movement as a unit about a common pivot for simultaneous pivoting thereof relative to said casing and relative to said cradle other end portion, said latch member and said magnet member being pivotally movable with respect to each other, biasing means pivoting said lower end portion of said latch member towards said cradle other end portion, and a bimetallic strip fixed at one end and extending through said field portion to generate a magnetic field therein upon passage of current therethrough, said bimetallic strip being deflectable by a sustained short circuit current of relatively low magnitude flowing therethrough to pivot said latch member and said magnet member about said common pivot in a direction so as to move said lower portions of said latch member and said magnet member away from said cradle against the pressure of the biasing means and thereby to release said cradle, said bimetallic strip upon passage of a sudden relatively high short circuit current flowing therethrough generating a magnetic field in said field portion of said magnet member of sufficient magnitude to pivot said latch member relative to said magnet member in a direction towards said field portion and thereby to release said cradle.

2. A circuit breaker as claimed in claim 1, wherein said bimetallic strip deflects into contact with said lower end of said magnet member upon passage of a sustained short circuit current therethrough to effect pivoting thereof and wherein said magnet member is engageable with said latch member to effect pivoting thereof upon said pivotal movement thereof by said bimetallic strip so as to release said cradle from said latch member.

3. A circuit breaker as claimed in claim 2, wherein connecting means are provided between said latch and magnet members to provide the engagement therebetween.

4. A circuit breaker as claimed in claim 1, wherein said bimetallic strip limits movement of said magnet member towards said latch member.

5. A circuit breaker as claimed in claim 1, wherein said biasing means acts upon said latch member above the pivotal connection between said latch and magnet members.

6. A circuit breaker as claimed in claim 5, wherein the common pivot for said magnet and latch members is spaced toward the upper ends thereof from said pivot therebetween



so as to provide a scissors-type action therebetween tending to pivot the lower ends of said magnet and latch members apart.

5 7. A circuit breaker as claimed in claim 6, wherein the upper end portions of said magnet and latch members above said pivot therebetween are angularly offset with respect to each other to permit pivoting of the one upper end portion relative to the other upper end portion for enhanced scissors-type pivotal action.

10 8. A circuit breaker as claimed in claim 1, wherein said pivotal connecting and supporting means in said casing includes a laterally extending arm portion at the upper end portion of one of said members and a cooperating shoulder portion on the upper end portion of the other member pivotably supported thereon.

20 9. A circuit breaker as claimed in claim 8, wherein said casing provides a shoulder supporting the lower surface of said arm portion.

25 10. A circuit breaker as claimed in any one of claims 1 to 7, wherein said pivotal connecting and supporting means includes a shoulder on the casing providing a pivot point and bearing surface for one of the members and a second shoulder on the casing provides sliding support for the other member to provide pivotal movement about a common pivot provided by said pivot point.

30 11. A circuit breaker as claimed in any one of the preceding claims, wherein there

is provided a common trip member pivotally mounted in said casing and pivotable against said latch member to effect release of said cradle, said latch member being pivotable towards said magnet member about the pivot therebetween. 35 40

12. A circuit breaker as claimed in any one of the preceding claims, wherein an ambient temperature compensating bimetallic strip is mounted at one end on said field portion of said magnet member and said first mentioned bimetallic strip bears thereagainst, said ambient temperature compensating bimetallic strip and said first mentioned bimetallic strip deflecting in the same direction in response to changes in ambient temperature to prevent undesired tripping of the breaker. 45 50

13. A circuit breaker as claimed in claim 1, wherein said bimetallic strip is fixed at said one end upon a conductor strap secured in said casing by a threaded member threadably seated therein and wherein said casing has a recess portion adjacent said threaded member to provide a pair of shoulders to opposite sides of said threaded member, said one end of said bimetallic strip being displaceable by rotation of said threaded member to draw said conductor strap towards the wall of said casing in said recess portion and produce deflection of the conductor strap. 55 60 65

POTTS, KERR & O'BRIEN.